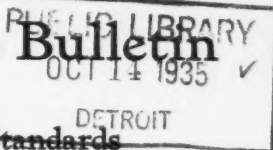


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## CONTENTS

Standard frequency radio broadcasting service.

A practical system of automatic radio signals from a free balloon.

Measurement of altitude in record flights.

Heat of combustion of isobutane.

Yield and purity of levulose derived from the calcium levulate process.

Quantitative determination of small amounts of silver.

Marking articles made of silver in combination with gold.

Atomic weight of gallium.

Production, heat treatment, and properties of iron and steel.

Determination of oxygen in steel.

Properties of carbon tool steels.

Steel for withstanding shock loads.

A specification for high-early-strength portland cement.

Air treatment for preservation of records in libraries.

Fiber building boards.

Wear of sole leather.

Deterioration of vegetable-tanned leathers by sulphuric acid.

Simplified packaging of automotive-engine parts.

Simplified packaging of air-brake parts.

Educational courses 1935-36.

New and revised publications issued during September 1935.

Letter circulars.

Recent Bureau articles appearing in outside publications.

## STANDARD FREQUENCY RADIO BROADCASTING SERVICE

The Bureau provides a standard frequency service which is broadcast by radio. Since October 1, this service has been given on 3 days each week, from the Bureau's station WWV, Beltsville, Md., near Washington, D. C. The object of these radio emissions is to provide a standard for scientific or other measurements requiring an accurate radio or audio-frequency or time rate. They are likewise useful to radio transmitting stations for adjusting their transmitter to exact frequency, and to the public generally for calibrating frequency standards.

On each Tuesday and Friday the emissions are continuous unmodulated waves (CW); and on each Wednesday they are modulated by an audio-frequency. The audio-frequency is in general 1,000 c/s (cycles per second). (There are no emissions on legal holidays.)

On all emissions three radio carrier frequencies are transmitted as

follows: Noon to 1 p. m., Eastern Standard Time, 15,000 kc/s (kilocycles per second); 1:15 to 2:15 p. m., 10,000 kc/s; 2:30 to 3:30 p. m., 5,000 kc/s.

The emissions on 5,000 kc/s are particularly useful at distances within a few hundred miles from Washington, those on 10,000 kc/s are useful for the rest of the United States, and those on 15,000 kc/s are intended to serve the western half of the United States and, to some extent, other parts of the world.

During the first 5 minutes of the 1-hour emission on each carrier frequency, announcements are given. For the CW emissions, the announcements are made by telegraphic keying and consist of the station call letters (WWV) and a statement of the frequency; this announcement is repeated every 10 minutes. For the modulated emissions, the announcements are made only at the beginning of the hour; they are given by voice and include the station call letters and a

statement of the carrier frequency and the audio-modulation frequency.

Except during the announcements, the CW emissions consist of continuous, unkeyed carrier frequency, giving a continuous beat note in the telephone receiver in heterodyne reception. The radiated power in the CW emissions is 20 kilowatts.

The modulated emissions, except during the voice announcements at the beginning of the hour, consist of an uninterrupted audio-frequency superposed on the carrier frequency. The radiated power is only 1 kilowatt; reception is therefore not as reliable as for the CW emissions of Tuesdays and Fridays; it is hoped to increase the power later. The modulated emissions are somewhat experimental, and for this reason an audio-frequency other than 1,000 c/s may be used on some occasions. The presence of the audio-modulation frequency does not impair the use of the carrier frequency as a standard to the same high accuracy as in the CW emissions.

The accuracy of the frequencies as sent out from the transmitting station is at all times better than 1 part in 5 million. Transmission effects in the medium (Doppler effect, fading, etc.) at times may result in slight fluctuations in the frequency as received at a particular place. However, these will practically never impair the reception of the carrier frequency to the accuracy stated. Under some conditions, momentary fluctuations as great as 1 c/s may occur in the modulation frequency. It will generally be found possible, however, to use the modulation frequency with an accuracy better than 1 part in a million by selecting that one of the three carrier frequencies which has the least fading. The use of automatic volume control on the audio-frequency will be found helpful.

Information on how to receive and utilize the standard frequency service is given in a pamphlet obtainable on request addressed to the National Bureau of Standards, Washington, D. C. From any single frequency, using harmonic methods, any frequency may be checked.

The Bureau welcomes reports of use and comments upon the standard frequency service. As the modulated emissions are somewhat experimental, the Bureau is particularly anxious to receive reports from those utilizing them, including: Description of method of use; statement of relative fading, intensity, etc., on the three carrier frequencies; and preference as to audio-

frequency to be furnished. Correspondence should be addressed National Bureau of Standards, Washington, D. C.

#### A PRACTICAL SYSTEM OF AUTOMATIC RADIO SIGNALS FROM A FREE BALLOON

A complete system, based on the Olland telemeteorograph, for obtaining signals by means of a radio transmitter, from instruments attached to free balloons, has been constructed at the Bureau. In this way records are obtained instantaneously by a receiver located on the ground. The wave length adopted is 5 meters, permitting convenient use of half-wave tuned doublet antennas for transmission as well as reception. The radio transmitter is "keyed" in such a way that signals are emitted only during several short contacts per minute, thus greatly reducing the size of the plate batteries required.

In this development the Bureau is working in close cooperation with the Weather Bureau in the belief that the system will prove valuable for obtaining meteorological data at great altitudes. The complete radio apparatus for attachment to a balloon weighs less than 2 pounds, and preliminary trials show that the signals can be heard clearly at altitudes of 14 miles and at distances of 80 miles. By employing a method of direction finding for the pulses emitted by this radiometeorograph the location of the balloon can be ascertained at the instant any pulse is sent out.

#### MEASUREMENT OF ALTITUDE IN RECORD FLIGHTS

Before July 1, 1935, the accredited altitudes in record flights had been determined by the single measurement of the lowest air pressure attained in the flight, converted to altitude by means of the altitude-pressure relation of the standard atmosphere of the Fédération Aéronautique (FAI) Internationale.

Since July 1, 1935, the FAI requires that the actual altitude of aircraft above sea level shall be determined in flights above 10,000 meters (32,808 feet) which are made in an effort to establish an international record. The altitude is to be computed from continuous measurements in flight of air pressure and temperature by means of the barometric altitude formula. A meteorograph installed on the aircraft exposed to the free air is specified to be used in making the necessary measurements.

In a paper by W. G. Brombacher, of the Bureau, at the aeronautic meeting of the American Society of Mechanical Engineers in St. Louis on October 10, a digest of the regulations is presented. Certain requirements appear to be undesirable, notably the requirement that the meteorograph installed in airplanes must be 0.4 of the wing chord in front of the leading edge of the wing. This awkward installation is unnecessary, since a suitable meteorograph can just as well be installed anywhere on the aircraft, where it is exposed to the free air, or, alternatively, indications of instruments installed in the fuselage can be photographicly recorded.

In balloons it is difficult to measure air temperature without artificial ventilation. For this reason it is necessary to provide for the use of instruments so equipped, either a meteorograph or an electrical thermometer and an aneroid barometer. If the latter instruments are used, photographic recording of the indications is required.

The regulations specify that instruments shall be calibrated within 15 days before the flight. This short interval is unnecessary to secure accuracy if certain other precautions are taken and is very inconvenient for flights in an area as large as the United States. It is suggested that the interval be increased to 2 or 3 months.

#### HEAT OF COMBUSTION OF ISOBUTANE

In the Bureau's thermochemical laboratory the heat of combustion of isobutane was recently measured, the only previous determination of this important thermochemical constant being that by Thomsen over 50 years ago on some impure material.

As set forth in RP833 in the Journal of Research for October, the new data yield, for the heat evolved in the combustion of gaseous isobutane in oxygen to form gaseous carbon dioxide and liquid water (at 25° C and a constant pressure of 1 atmosphere), the value  $2871.06 \pm 0.53$  international kilojoules per mole. With the factor 1/4.1833, this value becomes  $686.31 \pm 0.13$  kilocalories per mole. The isobutane used in the present experiments was estimated to be of such purity that its heat of combustion would differ from that of the absolutely pure material by less than 0.01 percent.

When combined with appropriate values for gaseous carbon dioxide and

liquid water, the new data yield values for the heat of formation of isobutane.

When combined with the previously reported data for normal butane, the new data yield a reliable value for the energy of isomerism of the two butanes at 25° C and 1 atmosphere:  $n$ -butane=isobutane,  $\Delta H = -1.63 \pm 0.15$  kilocalories per mole. This value indicates that at room temperature and 1 atmosphere the energy content of isobutane is less than that of normal butane by  $1.63 \pm 0.15$  kilocalories per mole.

#### YIELD AND PURITY OF LEVULOSE DERIVED FROM THE CALCIUM LEVLATE PROCESS

Levulose can be isolated from various crude plant juices, such as the Jerusalem-artichoke, dahlia, and chicory, by hydrolyzing (or converting) the polysaccharides to sugar with dilute acid and precipitating the levulose with lime. Lime combines with the levulose to form calcium levulate, which is relatively insoluble in water but is partially dissolved by sugars other than levulose which occur in the crude juices. The principal sugars which thus diminish the yield of levulate are dextrose and three isomeric difructose anhydrides which have recently been discovered in the products of hydrolysis of inulin. Inulin is a starch-like substance which occurs abundantly in the plants mentioned above and which upon treatment with acid yields levulose contaminated with about 5 percent of the difructose anhydrides. As described in RP832 in the October number of the Journal of Research, the effect of dextrose and the difructose anhydrides has been studied in quantitative experiments at the Bureau, and the conclusion drawn that dextrose is the principal impurity to be combated. The only way to avoid considerable losses of levulose during the processes of recovery is to select varieties of plants which have tubers with a relatively high proportion of levulose in the total sugar. There are many varieties of the Jerusalem-artichoke, some of which are characterized by this desirable high ratio of levulose in the total sugar.

After the levulose has been isolated in the form of calcium levulate which is washed free from impurities, the levulose is liberated from the lime compound by treatment with carbonic acid which combines with the calcium to form calcium carbonate. In previous experiments the resulting levulose

sirups were only 91 to 97 percent pure. It is found in the present investigation that impurity is introduced by permitting the solution to become alkaline. This alkalinity is produced by the decomposition of calcium bicarbonate by evaporation. In later experiments this defect of procedure was corrected by removing calcium bicarbonate with lime and acidification of the resulting solution with oxalic acid, these adjustments being made precisely by electrical conductivity measurements. With the adoption of the new method the purities of the levulose sirups rose to 99 percent.

#### QUANTITATIVE DETERMINATION OF SMALL AMOUNTS OF SILVER

As one phase of a recent investigation at the Bureau, sponsored by a group of American silver producers, a method for the quantitative determination of small amounts of silver in water was studied.

Need for such a method arises from the recent interest which has been manifested in this country and abroad in a method for sterilizing water, which employs small amounts of silver as the sterilizing agent. A colorimetric method for the quantitative determination of silver was developed in which the color is produced when an alcoholic solution of *p*-dimethylaminobenzalrhodanine is mixed with very dilute silver solutions. Silver may be determined with an accuracy of 3 percent or better in solutions containing as little as 0.06 mg/liter and up to 9 mg/liter without evaporation. New data were obtained on the adsorption of silver on the walls of soft glass, Pyrex, and silica containers and a procedure developed whereby adsorption effects may be overcome. This work is described in detail in RP836 in the October number of the Journal of Research.

#### MARKING ARTICLES MADE OF SILVER IN COMBINATION WITH GOLD

In the last 2 years repeated objections have been voiced as to the unfairness of the mark "10K and Sterling" or "10K on Sterling" when used on articles of sterling completely covered with gold or when the two metals are not distinguishable one from the other, because the mark is indeterminate, gives no clue to the relative proportion of the two metals and is therefore misleading and subject to abuse. In an effort to remedy the situation in the interests of the consum-

ers and fair trade, the Jewelers' Vigilance Committee requested the cooperation of the Bureau in establishing a commercial standard for silver and gold combinations. It was desired that the standard provide a more definite means for comparison of quality by the consumer, and a basis for fair competition among producers and distributors.

The resulting commercial standard, CS51-35, as now accepted by producers, distributors, and users, provides: That for articles completely covered with gold or where the two metals are not readily distinguishable one from the other, quality marks shall be recognized only when the ratio of gold to silver is 1/20th or more; that quality marks shall not be applied to articles of this description containing gold of less than 10-karat fineness; and that the proportion of the weight of the alloyed gold to the weight of the entire metal shall be included where quality marks are applied and the two metals are not visually separable and easily distinguishable one from the other, for example, "Sterling +  $\frac{1}{10}$  10K." Quality marks are to be applied so that the karat mark and its fractional prefix shall follow directly the "Sterling" mark, except when the fractional prefix is  $\frac{1}{2}$ , the karat mark may directly precede the sterling mark. Where the two metals are visually separable and easily distinguishable, articles may carry a quality mark "Sterling", followed by the karat fineness of the gold, i. e., "Sterling + 10K."

The commercial standard also lists the exemptions regularly recognized in the trade such as screws, catches, springs, etc.; includes the requirement that all quality marks must be accompanied by the manufacturer's name or registered trade mark as a means for determining responsibility for the quality marks; permits the use of class, pattern, or style marks, and suggests the wording of certificates and tags or other labels indicating to the buyer that the item is marked in strict accordance with the commercial standard.

The pamphlet includes a brief history of the project, a list of the official acceptors, and the membership of the standing committee. The standard became effective for new production on July 1, 1935, and is effective for clearance of existing on July 1, 1936. Copies are obtainable from the Superintendent of Documents, United States Government Printing Office, Washington, D. C., at 5 cents each.

### ATOMIC WEIGHT OF GALLIUM

During the past year a considerable quantity of metallic gallium, having a purity of at least 99.999 percent was prepared at the Bureau, and its melting point determined. This interesting metal melts at 29.780° C. and is the only metal, other than mercury, that is liquid at room temperature. Its history is somewhat romantic in that its existence, as well as a number of its properties, was predicted by Mendeléeff in 1869, 6 years before its discovery. Some years before Mendeléeff's announcement, Lecoq de Boisbaudran, working on the spectra of boron, aluminum, indium, and thallium, noticed a gap in the series and set out to find the missing element. He was rewarded in 1875 by the discovery of gallium which he named in honor of his country. Gallium thus was the first element to enjoy the reputation of being sought. This metal, like antimony and bismuth, expands during solidification.

Lecoq de Boisbaudran determined the atomic weight of gallium by converting gallium ammonium alum to gallic oxide and by converting the metal to gallic oxide through the nitrate. He obtained the values 70.12 and 69.70, respectively. The only other determination was made by Richards and Craig at Harvard, who prepared gallium trichloride. Their value, recalculated on the basis of the International Table of Atomic Weights for 1935, is 69.720.

Since the Bureau had available a larger quantity of pure gallium than had ever been prepared before, and since so few data existed for this fundamental constant which is becoming more and more important in modern chemistry, a new determination was made in which gallium was compared directly with the arbitrary standard, oxygen. Three methods of obtaining the oxides from the metal were used, namely, the conversion of metallic gallium to gallic oxide through (1) the hydroxide, (2) the sulphate, and (3) the nitrate. The value obtained is 69.74, which is in good agreement with the recalculated value obtained by Richards and Craig. For a more complete account of this work RP838 in the October number of the Journal of Research should be consulted.

### PRODUCTION, HEAT TREATMENT, AND PROPERTIES OF IRON AND STEEL

The numerous letters of inquiry received by the Bureau for practical information on the production, heat treat-

ment, and properties of iron and steel are believed to indicate a genuine interest among men in the plant in the underlying principles of processes and manipulations with which they come in daily contact. Many of these inquiries for specific information about iron and steel indicate a desire to undertake elementary studies of metallurgical processes and materials. In the attempt to meet the needs of a considerable group of such inquirers the Bureau has prepared a concise elementary account of the production, heat treatment, and properties of iron alloys, steel, cast iron, wrought iron, etc., which will appear in its circular series. Particular attention has been given in this account to the theories developed within very recent years of hardening steel and of the role of special alloying elements.

### DETERMINATION OF OXYGEN IN STEEL

Under the joint sponsorship of the National Bureau of Standards and the iron and steel division of the American Institute of Mining and Metallurgical Engineers, an international cooperative study of the various methods which are used for the determination of oxygen in steel is drawing to a close. This project is an attempt to define more precisely than has been possible heretofore the comparative merits and the limitations of each of these analytical methods. Eight steels, each representing a different combination of ferrous and manganoous oxides, silica, alumina, and sulphur, within the range of composition of commercial plain-carbon steels, were selected and examined for uniformity of composition. Specimens as nearly identical in composition as possible were prepared and distributed to each of the cooperating laboratories for determination of the oxygen contents by the method or methods preferred in that laboratory. The reports of these analytical results are being made to the Bureau, which is acting as a clearing house in the undertaking.

There are 36 laboratories at present engaged in active participation in the project, 20 in the United States and 16 in foreign countries. Already 25 of the laboratories have submitted their reports, and assembly of the data, classification of results according to the method used, and study of the various procedures for departure from normal has been started. The summary is far from complete and additional reports will be included as they are received. However, the divergence of results which is already evident is ample justification for undertaking the project.

## PROPERTIES OF CARBON TOOL STEELS

The mystery that for many years surrounded differences in hardenability of steels of quite similar compositions has recently been largely removed by the recognition of the influence of austenitic grain-size on hardening characteristics. RPS37 in the October number of the Journal of Research deals with the influence of the initial microstructure of tool steels on grain-size and hardening characteristics.

Widely used brands of 1-percent-carbon tool steels, produced by 1 foreign and 5 domestic manufacturers, were classified according to their depth of hardening. From these brands two steels of widely different depths of hardening were selected. Specimens of these steels were treated so as to have three different initial structures: (a) Spheroidized cementite; (b) coarse pearlite; and (c) sorbite, and a study was made of the effect of these initial structures on the austenitic grain-size and grain-growth, and on the critical cooling rates. These data also made possible a direct comparison of the relation between austenitic grain-size and critical cooling rate of the two steels over a range of quenching temperatures of 773 to 967° C (1,425 to 1,775° F).

A comparison was made of these two steels with respect to their behavior in the transformation temperature range during thermal analysis, relative rates of spheroidization of cementite, Charpy impact strengths, relative susceptibility to grinding cracks, structural normality, hardness on quenching with different rates, performance as lathe tools, and the effect of rate of heating to the hardening temperature on the depth of hardening.

## STEEL FOR WITHSTANDING SHOCK LOADS

Information on the relative resistance to shock loads of carbon steel and of an alloy steel proposed for the construction of large chains for lifting the gates of a dam in the Mississippi River was recently requested of the Bureau. The most convincing way of obtaining such information would be to subject chains of the two types of steel to shock loads and observe their behavior. Such tests were not practicable, however, since the chains were designed to have a lifting capacity of 1,000,000 pounds.

It is known that carbon and some alloy steels, when fractured by a sud-

den application of load, will, under certain conditions, show a fibrous fracture, whereas under other conditions the fracture will be granular and be produced by a considerably smaller shock load. The transition from "fibrous" to "granular" fracture may occur with a temperature drop of the order of 100 to 0° F. Other contributing factors are change in size, form, composition, and previous mechanical and thermal treatment. Some of these factors may cause the transition to occur at a higher temperature and some at a lower one. For a structure exposed to atmospheric ranges of temperature, the lower the temperature at which the transition from fibrous to granular fracture of the material occurs the greater the margin of safety to be expected under shock loads.

Charpy impact tests made on notched-bar specimens of the steels under consideration for the chains, at various temperatures ranging from -40° C (-40° F) to 100° C (212° F), showed that the transition from fibrous to granular fracture occurred at an appreciably lower temperature in the carbon steel than in the alloy steel. Many factors must, of course, be given due consideration in the choice of the steel to be used, but to the extent that the relative shock resistance of the carbon steel and alloy steel chains can be judged from the results, the tests indicated a greater margin of safety for the carbon steel.

## A SPECIFICATION FOR HIGH-EARLY STRENGTH PORTLAND CEMENT

RP839 in the October number of the Journal of Research deals with the testing of samples of 28 commercial high-early-strength portland cements. This work was undertaken by the Bureau to secure data on which to base a Federal specification for high-early-strength cement.

The cements were found to differ widely in composition and physical properties. The tricalcium silicate contents varied from 44 to 74 percent, the dicalcium silicate contents from 0 to 25 percent, and the tricalcium aluminate contents from 7 to 15 percent. The specific surfaces ranged from 1,990 to 2,860 cm<sup>2</sup>/g.

The cements were tested for compliance with tentative specification C74-30T of the American Society for Testing Materials. Two cements contained sulphuric anhydride in excess of the limit of 2.5 percent of this specification. Nine cements failed to meet the 1-day tensile strength require-

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ment of 275 lb/in.<sup>2</sup> and 10 failed to meet that of 375 lb/in.<sup>2</sup> at 3-days age.

Four plastic mortars, using a graded Ottawa sand, were studied. Mortar A had a cement:sand ratio of 1:2.75 and a C/W ratio of 2.0 by weight. Mortar B had a cement:sand ratio of 1:2.75 and the water content was gaged to give a flow of 100 to 110 percent on the 10-inch flow table. Mortar C had a C/W ratio of 2.0 and the sand content was gaged to give a flow of 100 to 110 percent. Mortar D had a cement:sand ratio of 1:2.77 and a C/W ratio of 1.88.

The flows of mortar A ranged from 59 to 105 percent. The C/W ratios of mortar B ranged from 1.72 to 2.00. The cement:sand proportions of mortar C ranged from 1:2.24 to 1:2.75. The tensile strengths of mortar A ranged at 1-day age from 170 to 290 lb/in.<sup>2</sup>, at 3-days age from 265 to 410 lb/in.<sup>2</sup>, at 7-days age from 320 to 455 lb/in.<sup>2</sup>, and at 28-days age from 390 to 420 lb/in.<sup>2</sup>. The compressive strengths of mortar A ranged at 1-day age from 1,030 to 2,230 lb/in.<sup>2</sup>, at 3-days age from 2,350 to 4,370 lb/in.<sup>2</sup>, at 7-days age from 3,270 to 6,300 lb/in.<sup>2</sup>, and at 28-days age from 4,250 to 7,100 lb/in.<sup>2</sup>. The strengths of mortars C and B, as a rule, were, respectively, above and below those of mortar A.

The rate of setting was measured by the penetrations of 300-g needles, one 1 mm in diameter and one 2 mm in diameter, into the plastic mortars contained in a Vicat ring. It is shown that this method could be used for determining "time of setting."

Six-inch prisms 1 inch square, after an initial period of 24 hours in a moist cabinet, were measured for length change under four conditions of curing.

The requirements for a specification for high-early-strength portland cement are discussed, and recommendations made for tests to be incorporated into such a specification.

#### AIR TREATMENT FOR PRESERVATION OF RECORDS IN LIBRARIES

The condition of the air in libraries has been found by the Bureau to be a vital factor in preserving important reference material. A summary of this phase of the Bureau's extensive studies relating to the preservation of records should be of interest to both air-conditioning engineers and librarians.

A survey of the condition of books and manuscripts stored in a number of large libraries revealed that high temperature and extreme dryness or wetness of the air were deteriorative in-

fluences, and there were indications that acidic sulphur dioxide gas from the combustion of fuels in congested areas was also a destructive agent. Papers exposed to this gas under controlled conditions in the laboratory deteriorated rapidly, and tests of papers from duplicate books which had been stored in libraries showed that those stored in air-polluted localities had deteriorated much more than those stored in localities where the air was relatively free from contamination. A study of the removal of the acidic gas from air entering a library resulted in finding that complete removal could be effected by washing the air with alkaline water.

As a result of this investigation, the Bureau recommends that if the value of the stored material warrants it, the temperature and relative humidity of library air be controlled within suitable limits, and that the air be washed with alkaline water to remove acidic gases and dirt.

#### FIBER BUILDING BOARDS

The manufacture of fiber building board has become an important industry during the past few years, and many tests of the properties of these boards have been made at the Bureau. Such tests have doubtless been helpful in improving the product. The boards are made largely from crudely refined vegetable fibers, from extracted licorice roots, tobacco stems, waste papers, bark, and other similar materials, and it is of particular interest that this list of fibrous raw materials is comprised largely of farm crop and industrial wastes.

The raw materials are softened for pulping by digesting in dilute acid or alkali or water under pressure, and the boards are formed on modified papermaking machines in continuous sheets which are dried over hot rolls or between heated platens. Moisture resistance is obtained by incorporating sodium resinate or waxes or by water-resistant surface coatings. Fiber board is used widely in home constructions in walls, roofs, attic floors, and basement ceilings as heat insulation, and in place of lath and plaster. In factories and office buildings, it is used extensively for roof insulation. Acoustic boards, which are essentially heat insulating boards with special surface modifications to increase sound absorption, are rapidly coming into extensive use as inside wall covering for theaters, auditoriums, hotels, restaurants, schools, and churches for the correction of acoustics.

## WEAR OF SOLE LEATHER

Chrome-tanned leather is known to be more durable than vegetable-tanned leather when used for shoe soles, but because the vegetable-tanned material excels in other valuable properties, such as firmness and water resistance, it is still widely used.

Manufacturers have tried to produce a leather by a combination of the two tanning processes which would have the good points of both. Many such "retanned" leathers are now on the market.

To ascertain the effect of this retanning on the durability of the leather, service tests were recently completed at the Bureau on 22 kinds of commercial leathers. The results, which are reported in the October number of the *Journal of Research* (RP834), show that the durability of the leather is in direct proportion to the predominance of the chrome tannage.

## DETERIORATION OF VEGETABLE-TANNED LEATHERS BY SULPHURIC ACID

In an investigation in progress at the Bureau on the effect of acids on the aging properties of leather, many materials used in conjunction with the vegetable tannins in the production of commercial leather have been studied. Among the materials considered likely to influence the deterioration of leather during storage were magnesium sulphate, sulphonated oils, sulphite cellulose extracts, synthetic tanning materials, and sulphited extracts.

It has already been shown that magnesium sulphate and sulphonated cod oil did not influence the deterioration of leather. RP835 in the October *Journal of Research* describes the results obtained with leather containing synthetic tanning materials (condensation products of coal-tar derivatives): Sulphite cellulose extracts (purified waste materials from the paper-pulp industry), and sulphited quebracho extracts (sodium bisulphite increases the solubility of ordinary quebracho extract).

The results show that vegetable leather tanned with the aid of these sulphur-containing compounds aged as well as leathers tanned with straight vegetable extracts, and that the deterioration as measured by the loss in tensile strength or by the extractable nitrogen started near pH 3 regardless of the amount of acid in the leather as determined by quantitative methods.

## SIMPLIFIED PACKAGING OF AUTOMOTIVE-ENGINE PARTS

Simplified Practice Recommendation R161-35, Packaging of Automotive (Bus) Engine Parts, which was adopted by the industry a short time ago, is based on the results of a study made by Purchases and Stores Committee No. 2 on standard packages of the American Transit Engineering Association.

The simplified schedule of standard packages, as developed by this committee, was officially adopted by letter ballot circulated among the operating membership of the American Transit Association and the recommendation is included in the Engineering Manual of the American Transit Engineering Association.

The Bureau was requested to submit this recommendation for packaging to the manufacturers, distributors, and users of parts for approval. The simplified schedule of package sizes, based on number of units in package, was found to be generally acceptable, and sufficient acceptances were recorded to make possible the promulgation of a simplified practice recommendation. This recommendation, which became effective September 1, 1935, covers a simplified schedule of standard packages for 26 different replacement parts for motor coaches operated by the various transit companies.

The general adoption of this recommendation for packaging should result in considerable savings and convenience in connection with storing, unit piling, inventorying, and distribution of parts.

A representative standing committee has been appointed to review this packaging simplification program periodically, to see that it is kept up-to-date and in line with the best current packaging practice of the industry.

Until the printed edition is available, complimentary mimeographed copies of the recommendations may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

## SIMPLIFICATION PACKAGING OF AIR-BRAKE PARTS

Simplified Practice Recommendation R162-35, Packaging of Air Brake (Electric Railway) Parts, recently adopted by the industry, is based on the results of a study made by Purchases and Stores Committee No. 2 on standard packages of the American Transit Engineering Association.



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The Bureau was requested to submit this recommendation for packaging to the manufacturers, distributors, and users of parts for approval. The simplified schedule of package sizes, based on number of units in package, was found to be generally acceptable, and sufficient acceptances were recorded to make possible the promulgation of a simplified practice recommendation. This recommendation, which became effective September 1, 1935, covers a simplified schedule of standard packages for 28 different compressor parts and 16 different governor parts, based on number of units in package.

The general adoption of this recommendation for packaging will result in considerable savings and convenience in connection with storing, unit piling, inventorying, and distribution of parts.

A representative standing committee has been appointed to review this packaging simplification program periodically, to see that it is kept up-to-date and in line with the best current packaging practice of the industry.

Until the printed edition is available, complimentary copies of the recommendation may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

#### EDUCATIONAL COURSES 1935-1936

Plans are now being formulated for a number of graduate study courses in physics, mathematics, and chemistry, to be given at the Bureau during the coming winter. Courses of this character have been given regularly for the past 27 years, and are recognized by many of the leading universities in allowing credit for advanced degree. Although these courses are planned primarily for members of the staff of the National Bureau of Standards, they are open on the same terms to any person who can furnish the instructor evidence of satisfactory preliminary training.

The Educational Committee has adopted the following two cycles as

constituting the fundamental part of a graduate training in physics.

#### Physics cycle—

Theoretical mechanics (due this year).

Electricity and magnetism.

Advanced optics.

#### Mathematics cycle—

Theory of functions (due this year).

Differential equations.

Fourier series.

One course of each cycle is normally given each year. However, in view of the fact that substantially all of the present staff of the Bureau has had an opportunity to take each cyclic course, these courses (*A* and *B*) will be offered tentatively, to be given only in case the advance registration is sufficient to justify them. Courses *C* and *D* are announced without this restriction. The reduced fee of \$15 per course, initiated last year, and applying to all applicants whether members of the Bureau staff or not, will be continued.

#### Course A.—Theoretical mechanics.—

Dr. F. G. Brickwedde. Sixty lectures given 2 hours per week throughout the year. The course covers the fundamental principles of kinematics and dynamics. The generalized equations of Lagrange and Hamilton will be derived and their applications illustrated by problems. Special consideration will be given to vibrations and cyclic motions, and to the gyroscope and gyrocompass. A few lectures at the end of the course will be devoted to special relativity and to the fundamental principles of quantum mechanics. Prerequisites: Calculus.

*Text:* The Dynamics of Particles and of Rigid, Elastic, and Fluid Bodies, by Arthur Gordon Webster.

*Course B.*—Theory of functions of a complex variable.—Dr. Tobias Dantzig. Sixty lectures given 2 hours per week throughout the year. The course covers a review of the fundamental mathematical notions and operations used in function theory; a review of the development of the number concept from the integer to the complex number; the fundamental theorem of algebra; the Cauchy-Rumann method and conformal representation; the Weierstrass method and infinite series and products, the elementary transcendental functions; beta and gamma functions; elliptic functions; functions defined by differential equations; applications to physical problems, pendu-

lum and gyroscope, planetary motion, potential theory, elasticity and hydro-mechanics, etc., with a brief consideration of their application to quantum mechanics. Prerequisites: Trigonometry, analytical geometry, and calculus.

*Text:* Goursat, Hedrick (or equivalent).

*Course C.*—Introduction to probability and statistics.—Dr. W. Edwards Deming. Sixty lectures given 2 hours per week throughout the year.

*First semester.*—Development of mathematical tools: moments of areas, theory of Sheppard's corrections, interpolation and the calculus of finite differences, the complete and incomplete gamma and beta functions and their tables, moments of more complicated areas. Asymptotic approximations to several events; the history of the normal curve and its tables. Fundamental notions of probability. The ergodic hypothesis and randomness. Sampling.

*Second semester.*—Induction and statistical inference: Probabilities associated with the mean and S. D. in samples, Fisher's notions of sufficiency, efficiency, and consistency. Tests for the significance of a single mean and S. D. History of Bayes' rule and inverse probability. Fiducial probability. Two or more samples. The Chi-test and the analysis of variance. Least squares, or the minimizing of Chi-square. The significance of parameters estimated by least squares. Systematic computation.

*Course D.*—Electrochemistry.—Dr. Edgar R. Smith. Sixty lectures given 2 hours per week throughout the year.

*Outline of course.*—The topics covered in this course will include electrode reactions; electrolytic conductance and transference; thermodynamics of electrochemistry; Debye-Hückel theory of activity coefficients; the e. m. f. of cells as a means of determining equilibrium constants and changes in free energy, entropy and heat content of chemical reactions; and incidental topics such as Brönsted's theory of acids and bases, electric moments of molecules in solution, standard cells, potentiometric titrations, etc. Prerequisites: Elementary calculus and physical chemistry.

The Educational Committee will welcome suggestions of other courses which might be arranged provided the registration is sufficient and suitable instructors may be obtained.

*Tuition.*—The fee for each 60-lecture course will be \$15. If desired the tuition may be paid in two installments, \$9 per course being due on or before

November 1, 1935, and \$6 on or before March 1, 1936.

For further information address the Educational Committee, National Bureau of Standards, Washington, D. C.

#### NEW AND REVISED PUBLICATIONS ISSUED DURING SEPTEMBER 1935

##### Journal of Research<sup>1</sup>

Journal of Research of the National Bureau of Standards, vol. 15, no. 3, September 1935 (RP nos. 822 to 831, inclusive). Price 25 cents. Obtainable by subscription.

##### Research Papers<sup>1</sup>

[Reprints from the June, July, and August 1935 numbers of the Journal of Research]

RP797. Mechanism of chromium deposition from the chromic acid bath. Charles Kasper. Price 5 cents.

RP804. Brightness meter for self-luminous dials. Leon F. Curtiss. Price 5 cents.

RP805. Method for measuring the pH of leather using a simple glass-electrode assembly. Price 5 cents.

RP808. Separation of a dimethylcyclohexane fraction from a midcontinent petroleum. Robert T. Leslie. Price 5 cents.

RP809. Separation of petroleum hydrocarbons with silica gel. Beveridge J. Mair and Joseph D. White. Price 5 cents.

RP811. Influence of sulphonated cod-liver oil on the deterioration of vegetable-tanned leathers by sulphuric acid. Everett L. Wallace, Charles L. Critchfield, and John Beek, Jr. Price 5 cents.

RP815. Color and spectral transmittance of vegetable oils. Harry J. McNicholas. Price 5 cents.

RP816. Factors affecting ultraviolet solar-radiation intensities. W. W. Coblenz and R. Stair. Price, 5 cents.

RP817. Isolation of ethylcyclohexane from a midcontinent petroleum. Frank W. Rose, Jr., and Joseph D. White. Price, 5 cents.

RP818. Effect of protective coatings on the absorption of moisture by gelatin-latex gas-cell fabrics. David F. Houston. Price, 5 cents.

RP819. Hydrothermal synthesis of kaolinite, dickite, beidellite, and nontronite. Raymond H. Ewell and Herbert Insley. Price, 5 cents.

RP820. Fractionation of the isotopes of oxygen in a commercial electrolyzer—a correction. Edgar R. Smith and Mieczysław Wojciechowski. Price, 5 cents.

RP821. Analysis of textiles for cellulose-acetate rayon, silk, regenerated-cellulose rayon, cotton, and wool. Ralph T. Mease and Daniel A. Jessup. Price, 5 cents.

Commercial Standards<sup>1</sup>

CS51-35. Marking articles made of silver in combination with gold. Price, 5 cents.

Miscellaneous Publications<sup>1</sup>

M152. Scientific and technical positions in the National Bureau of Standards. (Contains information regarding appointments and qualifications required for entrance to examinations). Free on application to the Bureau.

Technical News Bulletin<sup>1</sup>

Technical News Bulletin 221, September 1935. Price 5 cents. Obtainable by subscription.

LETTER CIRCULARS

It is the intent of the Bureau to distribute single copies of these Letter Circulars on request only to those parties having special interest in the individual Letter Circular. Economy necessitates limitation in the number of copies issued. It is not the intent to supply parties with a copy of each Letter Circular issued during the month. Letter Circulars are necessarily of a temporary nature designed to answer numerous inquiries on a given subject. Request should be addressed to the National Bureau of Standards.

LC446. Automobile engine oil filters.

LC447. A selected list of paper research literature of the National Bureau of Standards.

<sup>1</sup> Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, \$2.50 per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and the Republic of Panama); other countries, 70 cents and \$3.25, respectively.

OUTSIDE PUBLICATIONS<sup>2</sup>

Chemical reactions in the lead storage battery. George W. Vinal and D. Norman Craig. World Power (62 Lincolns Inn Fields, London, W. C. 2, England), 24, 75 (August 1935).

Intermediate pressures for orifice meters used in the measurement of gas. Howard S. Bean. Natural Gas (15 East 8th St., Cincinnati, Ohio), 16, 10 (September 1935).

The effect of water vapor on flame velocity in equivalent CO-CO<sub>2</sub> mixtures. Ernest F. Flock and H. Kendall King. Technical Report No. 531 (National Advisory Committee for Aeronautics, Washington, D. C.) (August 1935). Obtainable at 5 cents per copy from the Superintendent of Documents, Washington, D. C.

The dependence of reflectance and opacity on thickness; relation between contrast ratio and printing quality. Deane B. Judd. Paper Trade J. (10 East 39th St., New York, N. Y.), 101, TS40 (August 1, 1935).

The color and spectral transmittance of vegetable oils. H. J. McNicholas. Oil and Soap (400 E. Madison St., Chicago, Ill.), 12, 167 (August 1935).

Fiber building boards; their manufacture and use. C. G. Weber. Ind. and Eng. Chem. (Mills Building, Washington, D. C.), 27, 896 (August 1935).

A summary of the research work of the experimental paper mill of the National Bureau of Standards. M. B. Shaw. Paper Industry (333 North Michigan Ave., Chicago, Ill.), 17, 319 (August 1935).

Some observations on paper-testing problems. F. T. Carson. Paper Trade J. (10 East 39th St., New York, N. Y.), 101, 31 (August 22, 1935).

Influence of sulphonated cod-liver oil on vegetable tanned leather. Everett L. Wallace. J. Am. Leather Chem. Assn. (Ridgway, Pa.), 30, 438 (August 1935).

Sheet silver for chemical equipment. B. A. Rogers. Sheet Metal Industry (London, England), 9, 99 (February 1935).

<sup>2</sup> These publications are not obtainable from the Government unless otherwise stated. Requests should be sent direct to the publishers.



